

## PWM/VFM Step-up DC/DC Converter for White LED / PMOLED and General Use

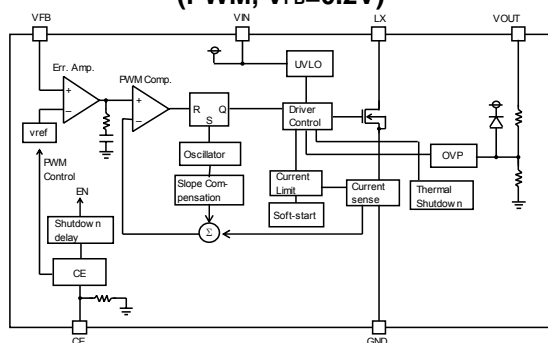
The R1204x Series are CMOS-based PWM/VFM step-up DC/DC converters, which are optimized to drive white LEDs and OLED with constant current. There are two types. The A/D versions are optimized for the general use or the drive of PMOLED, and the B/C/E/F version is optimized for the serial drive of white LED with constant current. The R1204x includes an under-voltage lockout circuit (UVLO), a soft-start circuit, and an over-voltage protection circuit (OVP), a thermal shutdown circuit. By simply using an inductor, divider resistors, and capacitors as external components, OLED and white LEDs can be driven with high efficiency. The A/D version can set white LED current with feedback resistor (R1). The brightness of the LEDs and the soft-start time can be adjusted by applying a PWM signal (200Hz to 300kHz) to the CE pin. In addition to DFN(PLP)1820-6, 0.95mm thickness TSOT-23-6 is available.

## FEATURES

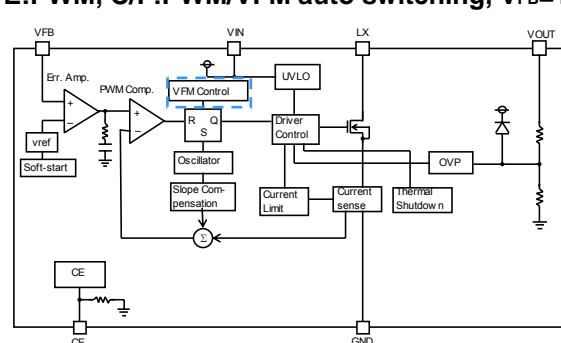
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|--|---|---|--|
| ● Supply Current ( $I_{DD}$ ).....           | Typ. 800 $\mu$ A ( $V_{IN}$ = 5.5V, $V_{FB}$ = 0V, Lx at no load) | ● UVLO Detect Voltage ( $V_{UVLO}$ ).....     | Typ. 2.0V  |
| ● Standby Current ( $I_{standby}$ ).....     | Max. 5 $\mu$ A ( $V_{IN}$ = 5.5V, $V_{CE}$ = 0V)                  | ● Coil-current Limit Circuit .....            | Current Limit Typ. 900mA                               |
| ● Input Voltage Range ( $V_{IN}$ ).....      | 2.3V to 5.5V  | ● Over Voltage Protection Circuit (OVP) ..... | Typ. 23V, Typ. 33V, Typ. 42V                           |
| ● Feedback Voltage ( $V_{FB}$ ) .....        | 0.2V (A/D Version)  | ● Soft Start Time ( $t_{start}$ ).....        | Controllable by PWM signal to the CE pin (A/D Version) |
|  | 1.0V (B/C/E/F Version)  |   | Typ. 10ms (B/C/E/F Version)                            |
| ● Feedback Voltage Accuracy .....            | $\pm 10$ mV (A/D Version)   | ● Thermal Shutdown Circuit .....              | Stops at 150°C   |
|  | $\pm 15$ mV (B/C/E/F Version)                                     | ● Packages .....                              | DFN(PLP)1820-6, TSOT-23-6                              |
| ● Oscillator Frequency ( $f_{osc}$ ).....    | 1MHz (A/B/C Version), 750kHz (D/E/F Version)                      |   |  |
| ● Oscillator Maximum Duty Cycle (Maxduty)... | Typ. 91% (A/B/C Version), Typ. 92% (D/E/F Version)                |   |  |

## BLOCK DIAGRAMS

**R1204xx1xA/D**  
**(PWM,  $V_{FB}=0.2V$ )**



**R1204xx1xB/C/E/F**  
(B/E:PWM, C/F:PWM/VFM auto switching,  $V_{FB}=1.0V$ )



Blue Line : only R1204xx1xC/F

## SELECTION GUIDES

Halogen Free	Package	Q'ty per Reel	Part No.
H/F	DFN(PLP)1820-6	5,000 pcs	R1204Kx12*-TR
H/F	TSOT-23-6	3,000 pcs	R1204Nx13*-TR-FE

**x** : Specify the OVP voltage.

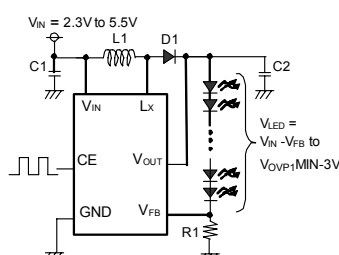
(1) OVP : 23V, (2) OVP : 33V, (3) OVP : 42V

\* : Specify the control, feedback voltage and oscillator frequency.

V <sub>FB</sub> =0.2V	V <sub>FB</sub> =1.0V
(A) PWM, 1MHz	(B) PWM, 1MHz
(D) PWM, 750kHz	(C) PWM/VFM auto switching, 1MHz
	(E) PWM, 750kHz
	(F) PWM/VFM auto switching, 750kHz

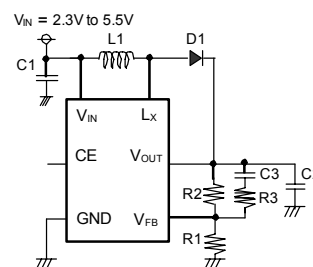
## TYPICAL APPLICATIONS

**R1204xx1xA/D**



L1: 10 $\mu$ H(A) or 22 $\mu$ H(D)  
C1: 1 $\mu$ F, C2: 1 $\mu$ F, R1: 10 $\Omega$

**R1204xx1xB/C/E/F**



L1: 10 $\mu$ H(B/C) or 22 $\mu$ H(E/F),  
C1: 1 $\mu$ F, C2: 1 $\mu$ F, C3: 10pF,  
R1: 10k $\Omega$ , R2: 240k $\Omega$ , R3: 0 $\Omega$

### PACKAGES (Top View)

DFN(PLP)1820-6

Diagram of the DFN(PLP)1820-6 package, showing a square package with 6 pins (3 on each long side) and a central square area with a small circle in the bottom-left corner.

1

V<sub>OUT</sub>

4

V<sub>IN</sub>

2

L<sub>X</sub>

5

CE

3

GND

6

V<sub>FB</sub>

TSOT-23-6

Diagram of the TSOT-23-6 package, showing a rectangular package with 6 pins (3 on each long side).

1

L<sub>X</sub>

4

CE

2

GND

5

V<sub>OUT</sub>

3

V<sub>FB</sub>

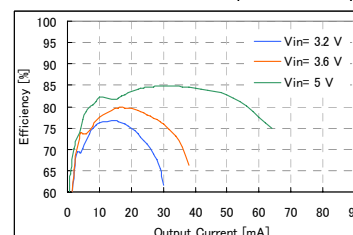
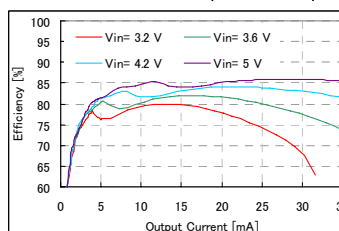
6

V<sub>IN</sub>

\*) The tab is substrate level (GND).

## TYPICAL CHARACTERISTIC

**Efficiency vs. LED Output Current** L=22μH (VLF302512MT220)  
R1204xx1xD (10 LEDs) R1204xx1xF (V<sub>OUT</sub>=31V)



## APPLICATIONS

- OLED power supply for hand-held equipment
- White LED backlight for hand-held equipment

## R1204x Version Lineup

Product Name	R1204xx1xA/D	R1204xx1xB/C/E/F
Application	White LED (Serial drive)	PMOLED, General Use
V <sub>FB</sub> Voltage	0.2V	1.0V
Comment	<p><b>LED Current setting</b> The LED current (I<sub>LED</sub>) when a "H" signal is applied to the CE pin (Duty=100%) can be determined by the value of feedback resistor (R1). <math>I_{LED}=0.2 / R1</math></p> <p><b>LED Dimming Control</b> The LED brightness can be controlled by inputting the PWM signal to the CE pin. The current of LEDs when High-Duty of the CE input is "Hduty" reaches the value as in next formula. <math>I_{LED}=Hduty \times V_{FB} / R1</math></p> <p>The frequency of the PWM signal is using the range between 200Hz to 300kHz. When controlling the LED brightness by the PWM signal of 20kHz or less, the increasing or decreasing of the inductor current might be make a sounds in the hearable sound wave area. In that case, please use the PWM signal in the high frequency area.</p> <p><b>Soft-Start Time</b> Unless otherwise V<sub>OUT</sub> is beyond the threshold (V<sub>f</sub> x number of LED lights), current will not flow through LEDs, as a result, V<sub>FB</sub> voltage will not increase. The IC increases V<sub>OUT</sub> by controlling the output of error amplifier to "H" and turning the Lx switch on and off for a certain period of time (until the current flow). At the mean time, the inrush current is controlled by gradually increasing the current limit. If V<sub>OUT</sub> is over the threshold (the current flows), the IC controls the soft-start function by gradually increasing the reference voltage of error amplifier.</p>	<p><b>The Method of Output Voltage Setting</b></p> <p>Output Voltage= (R1 + R2) / R1</p> <p>The total value of R1 and R2 should be equal or less than 300kΩ. Voltage rating of capacitor (C2) is recommended to use 1.5 times or more the output setting voltage.</p> <p><b>Soft-Start Time</b> The IC controls the soft-start function by gradually increasing the reference voltage of error amplifier. Soft-start begins when the output voltage of error amplifier is 0V and ends when it reaches the constant voltage. The soft start time is set to Typ. 10ms within the IC.</p>

## RICOH COMPANY, LTD. Electronic Devices Company



■ Ricoh presented with the Japan Management Quality Award for 1999.  
Ricoh continually strives to promote customer satisfaction, and shares the achievements of its management quality improvement program with people and society.



■ Ricoh awarded ISO 14001 certification.  
The Ricoh Group was awarded ISO 14001 certification, which is an international standard for environmental management systems, at both its domestic and overseas production facilities. Our current aim is to obtain ISO 14001 certification for all of our business offices.



Ricoh completed the organization of the Lead-free production for all of our products. After Apr. 1, 2006, we will ship out the lead free products only.  
Thus, all products that will be shipped from now on comply with RoHS Directive.

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**RICOH COMPANY, LTD.**  
Electronic Devices Company  
● Higashi-Shinagawa Office (International Sales)  
3-32-3, Higashi-Shinagawa, Shinagawa-ku, Tokyo 140-8655, Japan  
Phone: +81-3-5479-2857 Fax: +81-3-5479-0502